

## FTIR and Energy Dispersive X-ray analysis of medicinal plants, *Ocimum gratissimum* and *Ocimum tenuiflorum*

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**Abstract** - Plant is an important source of medicine and plays a key role in world health. Vibrational and energy dispersive X-ray spectra of leaves, stems and seeds from the two selected indigenous medicinal plants, *Ocimum gratissimum* and *Ocimum tenuiflorum* (family : Lamiaceae) have been studied with the help of FTIR and SEM-EDX. FTIR findings indicated the presence of characteristic functional groups like alkanes, alkenes, alkynes, alcohols, amides, amines, carboxylic acid, carbonyl compounds, carbohydrates (glycogen) and halogens. The results of SEM - EDX spectra have shown that the essential elements like Calcium, Magnesium, Copper, Zinc, Oxygen, Sodium, Iron, Selenium and Potassium were present in the selected medicinal plants. The obtained data will be helpful for making medicinal formulation and deciding dosage of the medicine made from these plants.

**Keywords:** Medicinal plants, FTIR, SEM-EDX, *Ocimum gratissimum*, *Ocimum tenuiflorum*.

### I. INTRODUCTION

Although modern medicine is well developed in most of the world, large sections of the population in developing countries still rely on the traditional practitioners, medicinal plants and herbal medicines for their primary care. Moreover during the past decades, public interest in natural therapies has increased greatly in industrialized countries, with expanding use of medicinal plants and herbal medicines [1]. Plant synthesize hundreds of chemical compounds for functions including defence against insects, fungi, diseases and herbivorous mammals. Therefore, the analysis of these chemical constituents would help in determining various biological activities of plants [2]. Numerous phytochemicals with potential or established biological activity have been identified. Medicinal plants and herbs like turmeric, ginger, basil leaves, mint and cinnamon are commonly used in Indian dishes and they offer several health benefits. Cold and flu, relieve stress, better digestion, strong immune system and the list is simply endless. The secondary metabolites produced by the plants are usually responsible for the biological characteristics of plant species used throughout the world. The microbial growth in diverse situations is

controlled by plant derived products. A variety of techniques can be used to determine and estimate the presences of phytoconstituents in medicinal plants. Spectroscopic technique is one of the most useful and popular tool used in the present study.

Basil is native to tropical regions from central Africa to Southeast Asia. It is a tender plant, and is used in cuisines worldwide. *Ocimum gratissimum*, also known as clove basil, African basil [3], and in Hawaii as wild basil [4], is a species of *Ocimum* in the family Lamiaceae. *Ocimum tenuiflorum*, commonly known as holy basil, tulasi or tulsi, is an aromatic perennial plant in the family Lamiaceae. It is native to the Indian subcontinent and widespread as a cultivated plant throughout the Southeast Asian tropics. *Ocimum tenuiflorum* is an annual or short-lived perennial plant that has been used as a culinary and medicinal herb for centuries. The species can grow in a variety of soil conditions, propagates by its small and numerous seeds, and grows rapidly. These plants have several medicinal values that depend on certain active chemical substances. These active chemical substances are believed to have physiological impact on the human body.

Fourier Transform Infra Red spectroscopy is a method of obtaining infrared spectra by first collecting an interferogram of a sample signal using an interferometer, and then performing a Fourier Transform (FT) on the interferogram to obtain the spectrum. An FTIR Spectrometer collects and digitizes the interferogram, performs the FT function, and displays the spectrum. This method allows the analysis of a relevant amount of compositional and structural information in plants. Moreover, FTIR spectroscopy is an established time-saving method to characterize and identify functional groups [5]. Mineral elements though usually form a small portion of total combination of most plant materials and of total body weight; it was nevertheless treated as physiologically important particularly in body metabolism [6]. Trace elements play both curative and preventive role in combating diseases. There is a vast scope to exploit the preventive medicinal aspects of various trace elements such as Ca, K, Mg, Na etc.

## II. RELATED WORK

SEM-EDX and FTIR techniques have been employed to analyze the elements and functional groups of these medicinal plants, *Ocimum gratissimum* and *Ocimum tenuiflorum*. Different parts of the plants contain different elements in various concentrations.

## III. MATERIALS AND METHODS

**Sample collection:** The leaves, stems and seeds of *Ocimum gratissimum* and *Ocimum tenuiflorum* plants were collected from CIMAP, Hyderabad and were washed with running tap water and then with distilled water. All materials were air-dried, cut into small pieces. The pieces were mechanically crushed and ground into powder. The powdered plant materials were kept at room temperature away from direct sunlight in closed dry plastic bags for further analysis.



Fig. 1. *Ocimum gratissimum* plant



Fig.2. *Ocimum tenuiflorum* plant

## Energy Dispersive X-ray Spectroscopy (EDX) Analysis

Scanning electron microscopy is a powerful technique which allows evaluating morphological changes on the surface. When SEM is combined with EDX technique, it can provide valuable input in determining the distribution of various elements on the surface [7]. The plant powder samples were subjected to the elemental analysis using Scanning Electron Microscope (SEM) with an energy dispersive x-ray spectrometer (EDX).

## FTIR Spectral Analysis

FTIR is the most powerful analytical tool for identifying the types of chemical bonds (functional groups) present in compounds. The wavelength of light absorbed is characteristic of chemical bond as can be seen in the annotated spectrum. Infrared spectra of powdered samples were recorded using Bruker alpha FTIR Spectrometer, between  $4000-400\text{ cm}^{-1}$ , in the mid IR region.

## IV. RESULTS

### SEM-EDX analysis :

The SEM -EDX spectra of the three parts of the selected medicinal plants were shown in figures 1-6. The results of the elemental composition were shown in table.1 and they were represented graphically in figures 7 and 8. Calcium, Magnesium, Copper, Zinc, Oxygen, Sodium, Silicon, Chlorine, Iron, Selenium, Potassium and Carbon are present in the plants. The element, Oxygen is abundant in the leaves of both the plants, while K, Mg, Cl, Na and Ca presented as moderate amount. Ca, K and Na are presented as highest percentage in the stems of *ocimum gratissimum*, *ocimum tenuiflorum* and seeds of *ocimum tenuiflorum* respectively. But Zn, Br, Fe, Si and Se presented only in trace quantities. Sodium and potassium are present in all the three parts of two selected plants.

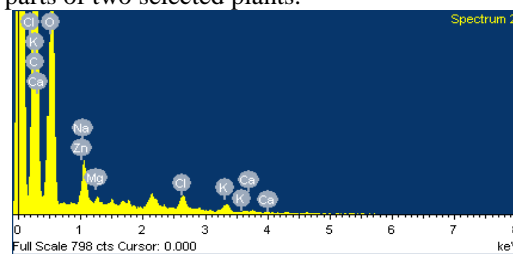


Fig 3 *O-gratissimum* leaf powder

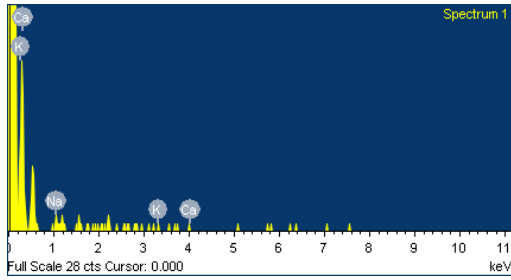


Fig 4 *O-gratissimum* stem powder

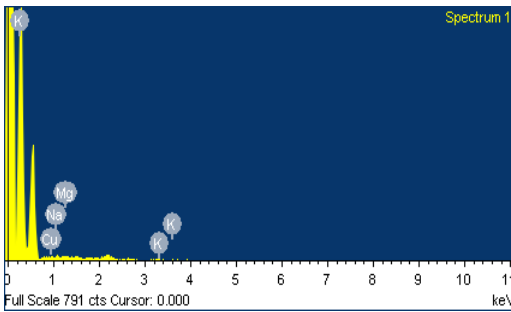


Fig 5 *O-gratissimum* seed powder

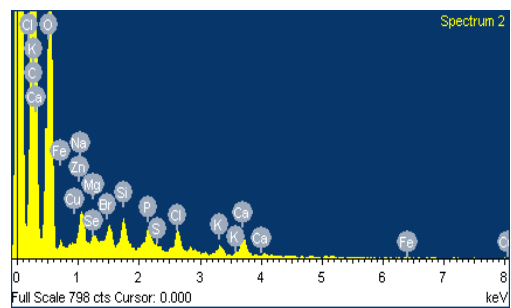


Fig 6 *O-tenuiflorum* leaf powder

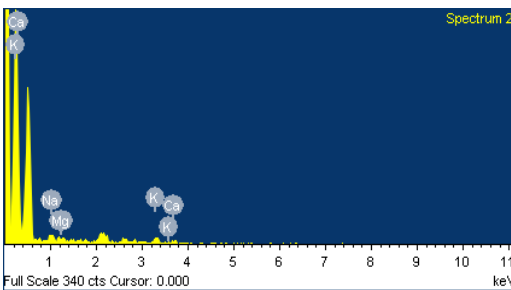


Fig 7 *O-tenuiflorum* stem powder

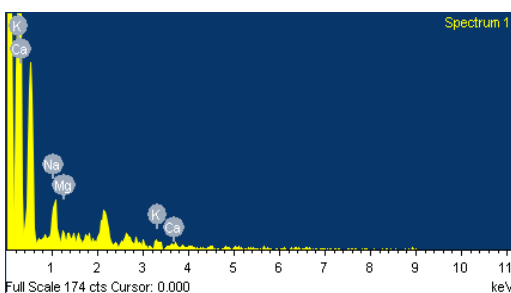


Fig 8 *O-tenuiflorum* seed powder

Table 1. Weight percentage of elements present in the three parts of the medicinal plants

Botanic al name	<i>Ocimum gratissimum</i>			<i>Ocimum tenuiflorum</i>		
	Leave s	Stem s	Seed s	Leave s	Stem s	Seed s
Mg	1.79	---	23.5	0.37	7.46	6.11
Ca	5.6	66.61	---	2.46	29.58	11.81
Br	---	---	---	2.06	---	---
Cu	1.26	---	12.17	---	---	---
Zn	---	---	---	0.08	---	---
O	68.83	---	---	40.23	---	---
Na	0.51	25.21	30.16	1.54	15.12	47.96
Cl	10.48	---	---	2.11	---	---
K	10.65	8.18	33.57	1.15	47.83	34.12
Fe	---	---	---	3.58	---	---
Cu	---	---	---	45.15	---	---
Si	---	---	---	1.49	---	---
Se	0.88	---	---	0.33	---	---

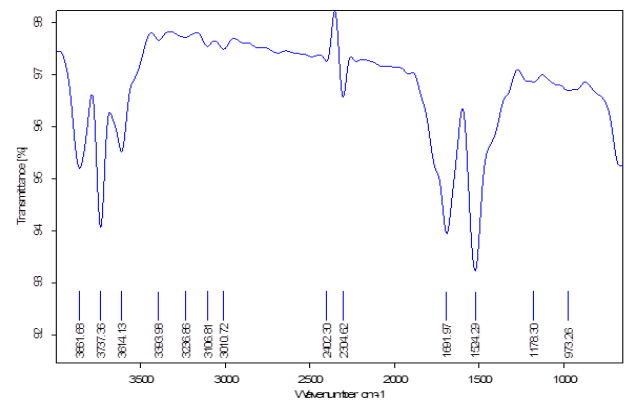


Fig-9 FTIR spectrum of *O-gratissimum* leaf powder

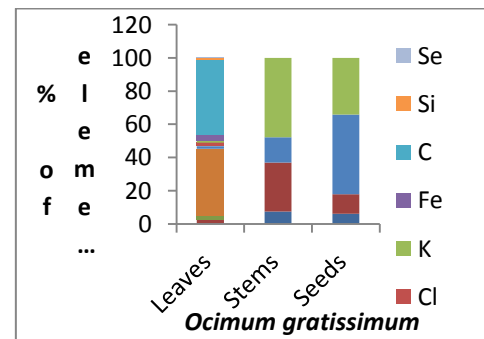


Figure 10

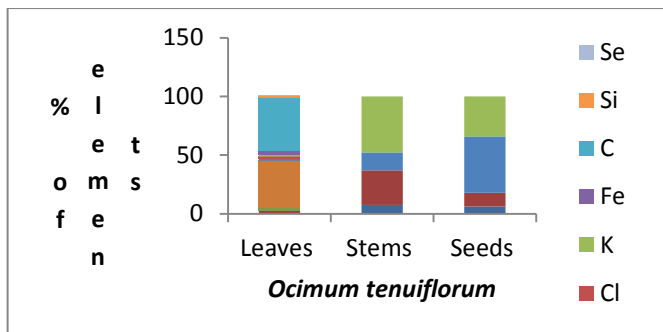


Figure 11

**FTIR analysis**

The FTIR spectra of plant parts like leaves, stems and seeds of selected medicinal plants are shown in figures 9 - 14. The FTIR findings indicated the presence of characteristic functional groups of alkanes, alkenes, alkynes, alcohols, amides, amines, carboxylic acid, carbonyl compounds, carbohydrates (glycogen) and halogen are present in the selected parts of the medicinal plants. The absence of absorbance in between the region 2220-2260  $\text{cm}^{-1}$  indicates that there was no cyanide group in the parts of medicinal plants. This results show that the selected medicinal do not contain any toxic elements.

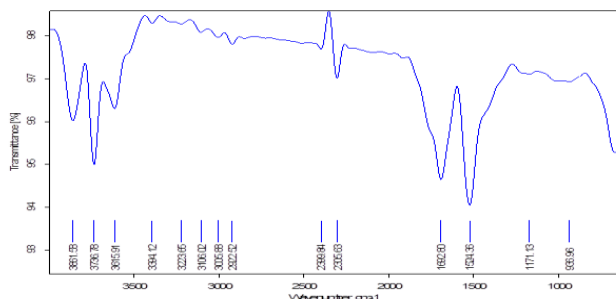


Fig 12 FTIR spectrum of *O- gratissimum* stem powder

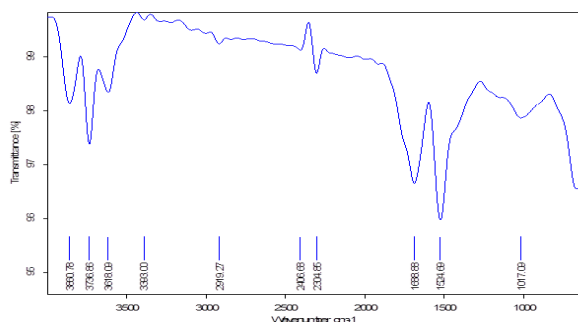


Fig 13 FTIR spectrum of *O-gratissimum* seed powder

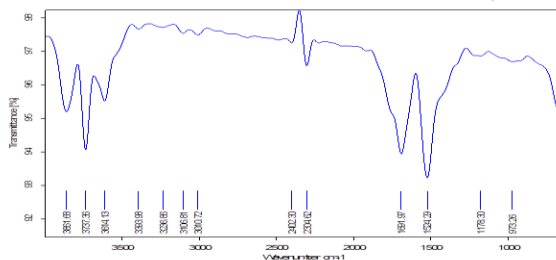


Fig-14 FTIR spectrum of *O-tenuiflorum* leaf powder

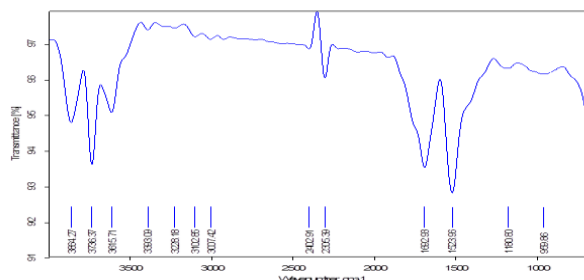


Fig-15 FTIR spectrum of *O-tenuiflorum* stem powder

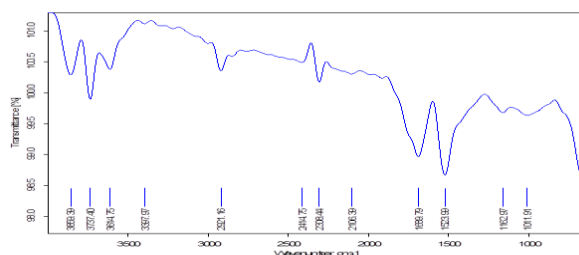


Fig-16 FTIR spectrum of *O-tenuiflorum* seed powder

**V. DISCUSSION**

Generally, Medicinal plants are being used in oriental medicine for treatment of ailment ranging from common cold to cancer [8]. Each element plays a number of different functions in the body. Zinc is a dietary mineral for humans and animals. Higher Zn intake protects people from cadmium poisoning while the symptoms of Zn overdose include vomiting, dizziness, fevers and diarrhea [9]. Copper is essential to all living organisms as a trace dietary mineral. The main areas where copper is found in humans are liver, muscle and bone. Copper compounds are used as bacteriostatic substance, fungicides and wood preservatives [10]. Copper has a number of important functions in the human body. It helps to produce red and white blood cells. Calcium is an important component of a healthy diet and a mineral necessary for life. It plays an important role in building strong and healthy bones and teeth both early and later in life [11]. Magnesium is essential to all living cells. Iron makes up part of many proteins in the body. It plays a vital role in many metabolic reactions. **Selenium** is an essential element required by plants and animals in trace quantities. Selenium is a powerful antioxidant that fights

oxidative stress and helps defend the body from chronic diseases, such as heart disease and cancer. The body uses **Sodium** to control blood pressure and blood volume. Our body also needs sodium for our muscles and nerves to work properly. The health benefits of **Potassium** include relief from stroke, high blood pressure, heart and kidney disorders, and anxiety and stress. It helps enhance muscle strength, metabolism, water balance, electrolytic functions, and the nervous system. **The selected plants contained all the above mentioned essential elements required for our body.**

## VI. CONCLUSION AND FUTURE SCOPE

The presence of various characteristic functional groups like alkanes, alkenes, alkynes, alcohols, amides, amines, carboxylic acid, carbonyl compounds, carbohydrates (glycogen) and halogens are responsible for various medicinal properties of both plants. The aim behind the quantification of the elements is to highlight their potential efficacy against certain health conditions which occur mainly due to mineral deficiencies. The elements contained in these **medicinal plants** may play vital role in human nutrition. The high level of elements in these **medicinal plants** show that the leaves, stems and roots of the *Ocimum gratissimum* and *Ocimum tenuiflorum* plants will be helpful for making medicinal formulation and deciding dosage of the medicine made from these plants to cure diseases caused due to mineral deficiencies.

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